INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 17, No. 6, p. 202-217, 2020

RESEARCH PAPER OPEN ACCESS

Assessment of asthma causes identified by spirometry in Lahore, Pakistan

Syed Shahid Imran Bukhari*, **Zulfiqar Ali**

Environmental health and wildlife lab, Department of Zoology, university of the Punjab Lahore, Pakistan

Key words: Asthma, *FEV_1, FVC, Obstruction, Restriction,* Spirometry.

http://dx.doi.org/10.12692/ijb/17.6.202-217 Article published on December 12, 2020

Abstract

This study was done to find out the causes of asthma in population of Lahore, Pakistan. Total of 2003 subjects from 9 administrative towns of Lahore, Pakistan were divided into 3 groups; G1 (normal), G2 (asthmatics with obstruction) and G3 (asthmatics with restriction) for spirometry over 1-year period (July, 2018-2019) at Jinnah hospital, Lahore using (Spirolab, IPX1FCC ID: TUK-MIR045 Roma-Italy). From 2003 subjects, 400 were randomly selected for questionnaire study consisting normal (n=200) and asthmatics (n=200). There were 60% records from male patients and 40% from female patients between the age limit of 07-104 years. Questionnaire depicted that more than 90% asthmatic subjects feel wheezy; 50% people did not have heredity asthma but had attached kitchen and bath; 60% people had complicated life style and joint family system; have pets, cockroaches, carpets and molds; more than 60% subjects use gas stove in their indoor. Data was analyzed using x^2 tests for questionnaire and Pearson's correlation coefficient (r) using SPSS (v.22). FVC and FEV_1 < 80% of value and FEV_1/FVC ratio < 70% were considered asthmatic. There was positive correlation between age ($p<0.05$) and FVC among G1 and G2. Age and prevalence of asthma were significantly positively correlated ($p<0.05$) in G3. G2 & G3 showed forces expiratory volume in 1 second (FEV_1) or peak expiratory flow (PEF) < 60%. FVC was significantly correlated positively ($p<0.05$) with asthma prevalence. There was significantly positive correlation ($p<0.05$) for asthma prevalence. Various factors under this study impair life quality of asthmatics.

* **Corresponding Author:** Syed Shahid Imran Bukhari ✉ shahid.phd.zool@pu.edu.pk

Introduction

Asthma is associated with chronic inflammation, respiratory passage hyper responsiveness (airway narrowing due to special triggers) that causes the reoccurrence of wheezing, chest tightness, breathlessness and coughing with varying intensity over time (Fassl *et al.,* 2012). Possible triggers of symptoms can be tobacco smoke, cold air, animal dander, pollens, molds and cockroach (Minov *et al.,* 2012). It can be result of genetic (Manuel *et al.*, 2014) and environmental interaction (Malinovschi *et al.,* 2013). It is much more frequent (Reinero *et al.*, 2011) along with its associated impairments and restrictions like physical, emotional and social hardships at workplace or school (Haczku *et al.,* 2010). Besides botheration of symptoms everyday life activities may also get limited by exposure to environmental stimuli and allergens such as smoke (Tasai *et al.,* 2010). Specific indoor quality parameters must be included to quantify asthma effects on everyday life of patient (Krieger *et al.,* 2010).

About 300 million people in the world are suffering from respiratory problems (Krieger, 2010). Approximately 12% (9 million) children only in U.S have asthma (Bloom and Dey, 2004) and an inner-city environment has progress to add up at an alarming rate (Akinbami and Schoendorf, 2002). Hospital admission and mortality rate due to asthma at Chicago exceeded in every category of age from 1990-1997 (Thomas and Whitman, 1999). In Pakistan it has been affecting approximately 30% of population (Khan *et al.,* 2014) with prevalence of 19% among children and 5-10% in adults. It has been predicted that it will increase in future in Pakistan and other developing countries (Khan *et al.,* 2014). Asthma most often begins in early childhood (John *et al.,* 2010) and increasingly affect by the age of 18 years (Yeatts *et al.,* 2003). Asthma has a prominent effect on life quality, medical cost and wages (Rhee *et al.,* 2014). Due to poor control of asthma there is increased morbidity, overall life impairments and daily activities limitations (Asthma UK, 2008). Questionnaire based findings showed frequency rate from 1-5 cases of 1000 person/yr as published in USA, Spain, Italy and Scandinavia as per reports over last 10 years (Magnoni *et al.,* 2017). Patient history is linked with important questions including wheeze, shortness of breath, chest tightness and recurrent cough during initial diagnosis (Moore *et al.,* 2010). Positive family history of asthma is always useful to identify patients. Results of questionnaire based clinical studies related life standard of asthmatics suggest life impairment in subjects with asthma (Bergen *et al.,* 2014). Large population based surveys rely on questionnaires because of being comparatively economical as compared to examination of each subject but regrettably it is not possible to formulate totally reliable questionnaire because of complexities like lack of medical knowledge, wide range of severity and triggers of disease among the general public. Symptom based questions like wheeze are thought to be most reliable questions in diagnosing asthma (Amato *et al.,* 2015). Role of spirometry is emphasized by COPD guidelines in identification of respiratory diseases and its management (Yawns *et al.,* 2007). Spirometer enables recording and storage of pulmonary expiratory flow (PEF), forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). PEF or reproducibility criteria for spirometry are difficult to be met by patients with asthma than normal subjects (Chae *et al.,* 2011). Mostly reduced FEV_1/FVC ratios exhibit airflow obstruction. Decline in FEV_1 is considered as measuring sign of obstruction in air flow in lungs (Ayubi and Safari, 2017). Still the proper cutoff values for FEV_1/FVC are controversial. Chronic obstructive lung disease committee first of all published levels of FEV_1/FVC <0.70 and FEV_1 to determine the disease severity in 2001 (Pauwels *et al.,* 2004). Spirometry is considered possible above 6 years age. Mostly general practitioners (GPs) do not recommend their patients with respiratory problems for spirometry (Johns *et al.,* 2006). Common barriers that come for the utilization of spirometry by general practice are lack of properly trained staff (Eaton *et al.,* 1999), shortage of time, lack of daily practice (Poels *et al.,* 2006), unavailability of spirometer in the clinic (O'Dowd *et al.,* 2003) and inefficiency of GPs to interpret the test results of spirometry (Raghunath *et al.,* 2006).

Spirometry needs a spirometer, well trained personnel under guidelines of American thoracic society (Miller *et al.,* 2005) and pulmonologists having information for result interpretation. However, expert panel reports by national asthma education and prevention program (NAEPP) guideline underestimate the value of spirometry for asthma diagnosis (Yawn *et al*., 2007). Asthma diagnosis needs a thorough assessment of lungs function in patients to know the variable expiratory airflow limits for confirmation of diagnosis (Melbye *et al.,* 2011) especially forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1) and predicted value for the FEV_1/FVC ratio (Kaminsky *et al.,* 2005). Previous non randomized simulation studies have shown the influence of spirometry on the management of GPs' diagnostics (Tashkin and Cooper, 2004; Wadson and Sanford, 2013) but recent non randomized studies confirm the increased diagnostic rates (Wadsworth and Sandford, 2013) of respiratory disease. Without the evaluation of spirometric results the whole way of asthma treatment may be changed totally on seeing spirometric results (Lange *et al.,* 2012). Now spirometry has become a prerequisite for diagnosis of respiratory diseases (Andrew *et al.,* 2012) and is need of the time.

Materials and methods

Study area

The historic city Lahore (31°15'-31°45' N and 74°01'-74°39' E) is common provincial capital of Punjab and 2nd biggest city of Pakistan. Lahore comprises of 9 managerial towns and a cantonment (Sidra *et al.,* 2015). Population of Lahore is about 12,188,000 till June, 2019 (UN, 2019) (Fig. 1).

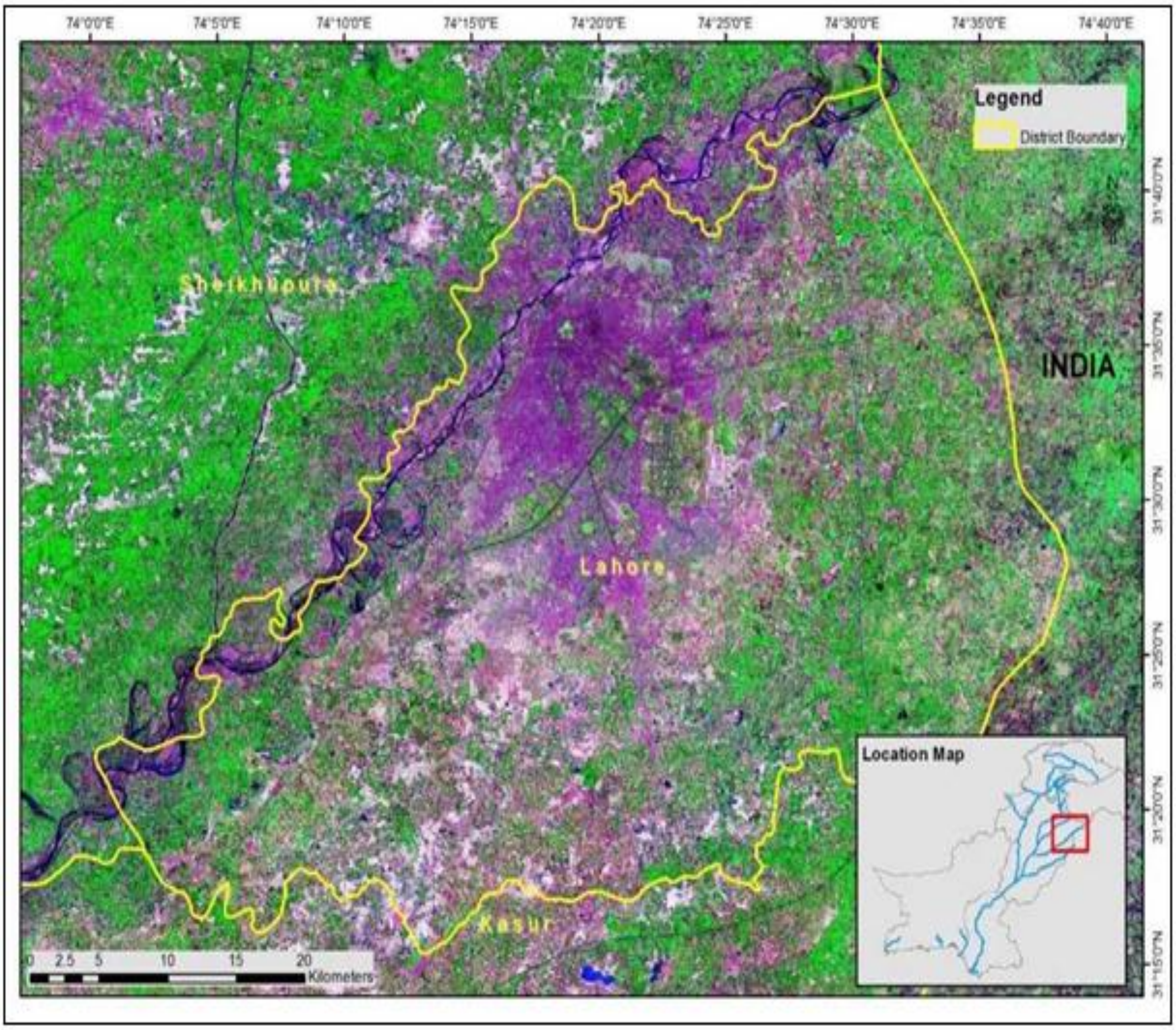

Fig. 1. Map of Lahore city showing areas of indoor sampling.

Summer is hot and dry with average 24.3°C temperature (Sidra *et al.,* 2015). Winters experiences typically max 17-22°C and the min temperature extending between 7-12 °C (Sidra *et al.,* 2015; Alam *et al.,* 2012). Lahore city encounters yearly precipitation 600-800mm. Every year city gets 3,094 hours of daylight (Pakistan Meteorology Department).

Study design

Total of 2003 subjects were divided into 3 groups; G1 (normal), G2 (asthmatics with obstruction) and G3 (asthmatics with restriction) for spirometry over 1-year period (July, 2018-2019). Study was designed for random trials. Subjects were recruited from outdoor patients at Jinnah hospital, Lahore. G2 were further falling into 4 categories e.g. severe obstruction (G2A), moderate obstruction (G2B), mild obstruction (G2C) and obstruction with restriction (G2D).

Subjects in G3 were further falling into 3 categories e.g. severe restriction (G3A), moderate restriction (G3B) and mild restriction (G3C). Severity of asthma was taken from medical records (if available) including history, medication, diary card and spirometry (Fig. 2&4).

Asthmatic group

Asthmatic subjects were diagnosed by pulmonologists. Asthmatic group thought to have symptoms like wheezing, nocturnal cough along with episodes of breath shortness (Global Initiative for Asthma).

Inclusion criteria

Subjects were included on the basis of previously existing symptoms or treatment for asthma.

Exclusion criteria

Subjects were excluded without previous asthma symptoms or treatment.

GPS use

GPS (Garmin eTrex® 30X by Garmin Ltd Taiwan) was used to take coordinates of the location of all subjects. After collecting data, location of all the subjects was mapped (Fig. 3).

Spirometry

The spirometry test system contains FVC, FEV_1, FEV_1/FVC, FEP and FEF2575. Over period of 1 year, 2003 consecutive spirometry records from adult patients (age>06 years) were analyzed. With all the subject's spirometry was performed using (Spirolab, IPX1FCC ID: TUK-MIR045 Roma-Italy). Spirometric indices such as FVC, FEV_1, FEV_1/FVC, FEP and FEF2575 ratio were recorded by experienced tech-nicians using American thoracic society guidelines.

Highest values were noted at body temperature and pressure. Spirometry test results of groups with flow volume curve, graphical interpretation and textual interpretative notes were collected. Volume time curve of control group was introduced in the asthmatic group for comparison. Spirometry was performed using a dry rolling seal spirometer (Spirolab, IPX1FCC ID: TUK-MIR045 Roma-Italy). Spirometric indices such as FVC, FEV_1, FEV_1/FVC, FEP and FEF2575 ratio were measured by experienced technicians using American thoracic society guidelines at Jinnah hospital Lahore.

Questionnaire study

Out of these 2003 subjects 400 subjects were scrutinized on the basis of their willingness for questionnaire study. One group was designated as normal (n=200) and other asthmatics (n=200).

These subjects were randomly selected on the basis of their location and socioeconomic status.

All of the 400 respondents were asked to complete questionnaire. Data about questionnaire was collected by each subject regarding name, gender, daily activities, health status, smoking, fuel type at home and living conditions (Fig. 5&6).

Ethical approval

Study protocol was authorized by ethical review committee vides number D/1315/UZ and consent was taken from participants.

Statistical analysis

Data was analyzed by using x^2 tests for questionnaire study and Pearson correlation to identify variables that significantly affected discordant classification of results. SPSS (v. 22.0) was used. A p-value less than 0.05 considered statistically significant.

Results

Data collection

There were 60% records from male patients and 40% from female patients. Subjects were between 07 to 104 years of age with asthma. There were significant differences in quality of life scores between patients with normal lung function and asthma. A questionnaire data of normal subjects showed that more than 90% do not have asthma symptoms and hereditary asthma. Most of the normal subjects do not have complicated life style and joint family system. More than 50% normal subjects have attached kitchen and bath. Less than 30 people have pet at their home (Fig. 5). Whereas, more than 90% asthmatic subjects showed wheezing and asthma symptoms, almost 50% subjects do not have heredity asthma. Most of them have complicated life style and joint family system. Almost 50% subjects have attached kitchen and bath. More than 60% subjects use gas stove indoor. More than 60 people have pet, cockroaches, carpets and molds at their home (Fig. 6). Data was found statistically significant showing p value < 0.05 (Table 1&2).

Table 1. Normal, obstructive and restrictive values of age, BMI, FVC, FEV_1, FEV_1/FVC and PEF of asthmatic patients.

Parameters	Normal	Obstructive				Restrictive		
	Mean±SD	Severe Obstructive Mean±SD	Mild Obstructive Mean±SD	Moderate Obstructive Mean±SD	Obstructive/Restrictive Mean±SD	Severe Restrictive Mean±SD	Mild Restrictive Mean±SD	Moderate Restrictive Mean±SD
Age	37.02±17.39	53.13±15.07	51.72±17.10	48.14±18.71	54.80±16.28	49.76±18.13	40.16±16.99	44.68±18.49
BMI	25.82±10.20	22.95±6.30	25.03±6.05	24.34±7.120	26.98±9.74	24.82±7.610	25.66±0.69	25.33±6.63
FVC (L)	2.84±0.69	2.75±0.59	3.75±0.65	2.66±0.64	2.43±.597	2.48±0.69	2.87±0.69	2.68±0.66
FEV1 (L)	2.31±0.59	2.09±0.52	3.75±18.25	2.07±0.58	1.84±0.51	1.93±0.59	2.31±0.60	2.13±0.59
FEV1/FVC%	72.90±6.02	68.19±4.70	68.84±5.22	69.54±5.70	68.35±4.30	69.77±7.89	71.65±4.89	70.78±4.99
PEF	6.36±16.13	5.89±1.22	5.76±1.37	5.64±1.27	5.15±1.33	5.24±1.39	8.93±45.85	5.57±1.39

Abbreviations: FVC: forced vital capacity; FEV1: forced expiratory volume; PEF: peak expiratory flow.

Table 2. Frequency of recorded parameters and association of health conditions with different variables. Chi square test (p-values).

Serial No	Question Statement	Frequency of Normal	Frequency of Asthmatic	$\chi 2$	P value
1	Feel wheezing or chest congestion	5.0%	92.0%	338.797[a]	<.001
2	Have Asthma	0.0%	83.0%	308.881[a]	<.001
3	Inherited Asthma	0.0%	24.0%	123.028[a]	<.001
4	Active smoker	3.0%	37.0%	87.426[a]	<.001
5	Passive smoker	21.0%	49.0%	40.212[a]	<.001
6	Type of dwelling is joint family	21.0%	43.0%	39.177[a]	<.001
7	Complicated family lifestyle	15.0%	48.0%	64.212[a]	<.001
8	Evidence of moisture or leaks	23.0%	52.0%	49.684[a]	<.001
9	Is kitchen attached to living area	70.0%	41.0%	36.473[a]	<.001
10	Attached washroom to living area	61.0%	52.0%	20.157[a]	<.001
11	Have carpets or rugs at home	56.0%	46.0%	23.984[a]	<.001
12	Indoor Kitchen gas stoves	56.0%	56.0%	8.123[a]	.017
13	Kitchen with outside vented hood	40.0%	53.0%	14.374[a]	.005
14	Residential location urbanized	70.0%	54.0%	17.436[a]	<.001
15	Industrialized Residential location	22.0%	47.0%	56.594[a]	<.001
16	Presence of cockroaches at home	47.0%	43.0%	1.556[a]	.459
17	Presence of rodents at home	30.0%	43.0%	16.393[a]	<.001
18	Presence of molds	23.0%	49.0%	36.919[a]	<.001
19	Pillows have zipped covers	63.0%	44.0%	14.725[a]	<.001

Spirometry

Over 1-year period (July 2018-2019) total 2003 subjects were selected for spirometry, recruited from outdoor patients at Jinnah hospital, Lahore (Fig. 3). Subjects in G2 (n=459) were with obstruction, G3 (n=692) were with restriction and G1 (n=852) were normal. G2 includes 121 G2A (121), G2B (53), G2C (125) and G2D (160) ($\chi 2$= P<0.005). Whereas, in G3, G3A (288), G3B (166), G3C (238). G1 (control group) received the normal volume-time curve which was used for comparison to asthmatic group. G1 had no chest symptoms with FEV_1 > 90% predicted. G2 & G3 showed FEV_1 or PEF > 60% (Fig. 4).

Table 3. Correlation coefficient lungs parameters and various groups.

	Groups	Height	Weight	BMI	FVC	FEV1	FEV1/ FVC	PEF
	Normal	.022	.277**	.215**	-.360**	-.563**	-.814**	.010
Obstruction	Severe obstruction	-.075	-.041	.012	-.592**	-.751**	-.814**	-.554**
	Mild Obstruction	.146	.094	.110	-.378**	-.569**	-.938**	-.185
	Moderate Obstruction	.082	.014	.020	-.453**	-.126	-.776**	-.335**
	Obstruction/ Restriction	.216**	.004	-.207*	-.403**	-.579**	-.887**	-.369**
Restriction	Severe Restriction	.010	.038	.072	-.477**	-.658**	-.610**	-.407**
	Mild Restriction	-.115	.102	.212**	-.525**	-.722**	-.857**	-.430**
	Moderate Restriction	-.146*	.173**	.245**	-.501**	-.678**	-.785**	-.016

**Correlation is significant at the 0.01 level (2-tailed). Correlation is significant at the 0.05 level (2-tailed).

Correlation

It was found that there was significant positive correlation (p<0.05) with the prevalence of asthma. Almost 42.5% subjects of G1 had normal spirometry, 22.91% of G2 and 34.54% of G3 had obstructive and restrictive patterns respectively. Conversely, 22.91% of subjects with an obstructive pattern (G2) interpreted were classified as 26.36% severe obstruction, 11.54% moderate obstruction, 27.23% mild obstruction and 34.85% obstruction with restriction. Conversely, 34.54% of subjects with restriction pattern (G3) interpreted were classified as 41.61% severe restriction, 23.98% moderate restriction and 34.39% mild restriction. FVC and FEV_1 < 80% of the predicted value and FEV_1/VC ratio < 70% were considered asthmatic. FVC, FEV_1 and FEV_1/FVC were used as the basic variables to interpret spirometry data. Subject in G2 were having FEV_1/FVC less than the LLN for that subject so categorized as obstructive pattern. Subjects in G3 were having FVC less than the LLN associated with a normal FEV_1/VC ratio for that subject so categorized as restrictive pattern. Subjects in the mild group had spirometric indexes and FVC values similar to the normal subjects. Subjects with moderate obstruction asthma had FVC and FEV_1 values within the healthy range, but flows at low lung volumes (FEF_{50} and FEF_{75}) were significantly lower. In subjects with severe obstruction and restriction all parameters were significantly reduced (Table 3).

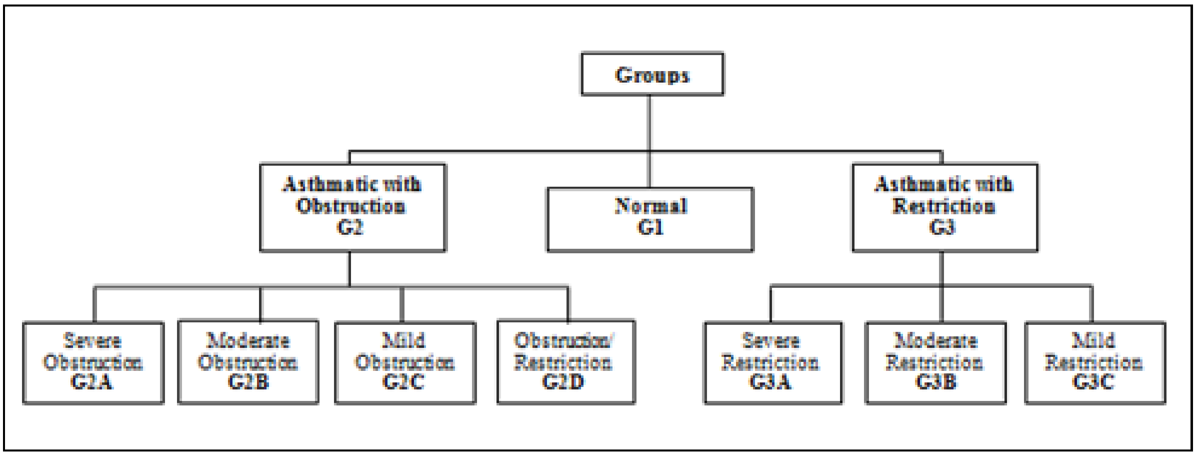

Fig. 2. Flow sheet showing various groups under study.

It was found that age was positively correlated ($p<0.05$) with the prevalence of asthma among G1 (Fig. 7). Age showed significantly positive correlation ($p<0.05$) with the prevalence of asthma G2 (Fig. 8). Age was significant positively correlated ($p<0.05$) with the prevalence of asthma G3 restriction group except mild restriction (Fig. 9).

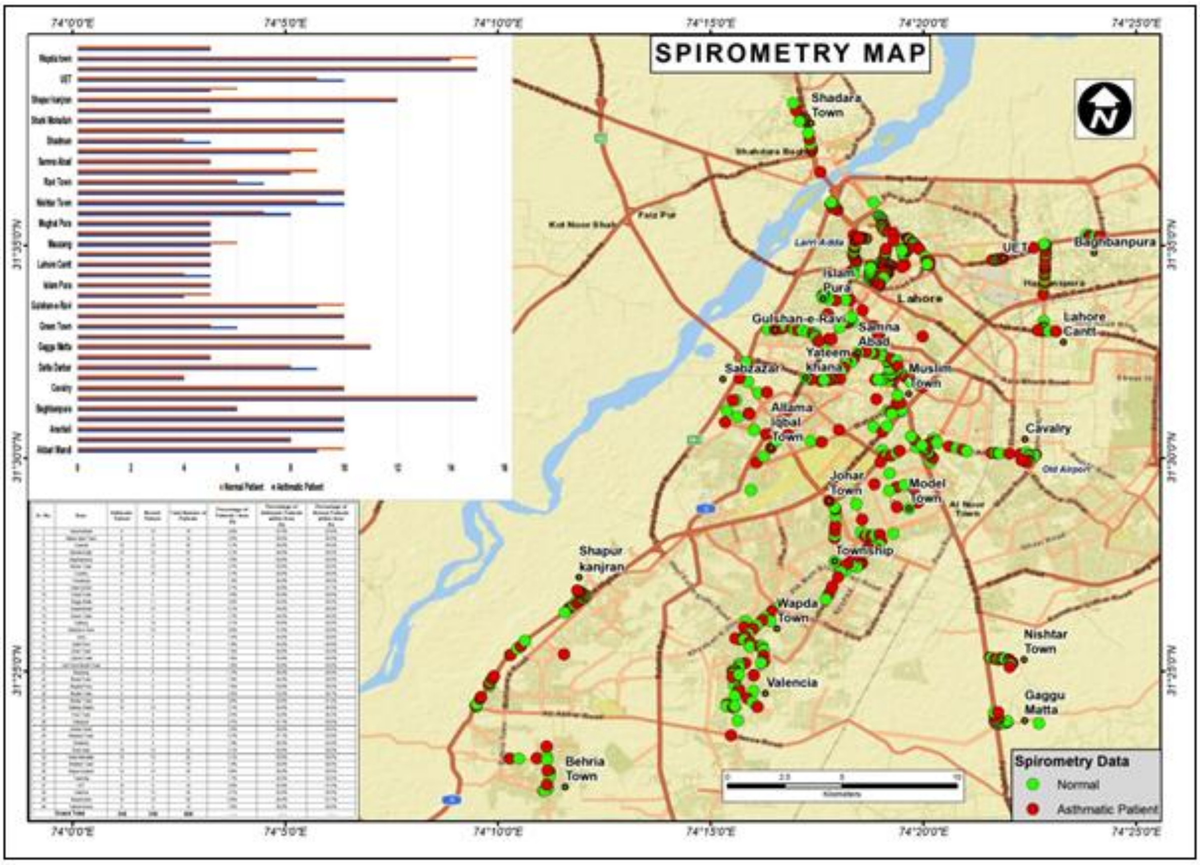

Fig. 3. Map showing GPS prevalence of asthmatic patients. The symbols of 50% red circle indicate (asthmatic) and 50% green circle indicate (normal).

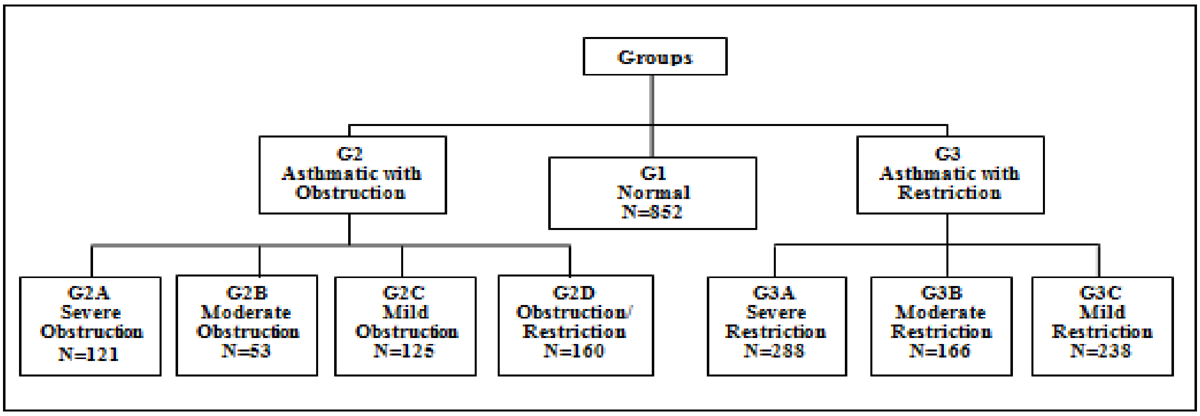

Fig. 4. Flow sheet showing various groups under study.

Discussion

The current study covered 10 major towns of the city as reported by another study support this study (Nafees *et al.,* 2013). Four hundred subjects were selected, inherent in any cross-sectional survey limitations. Questionnaire included all the potential questions needed for identification of asthmatic patients. Similar questions were selected by other

(Bergen *et al.,* 2014) and reported on indoor exposures (Sun *et al.,* 2007). Both normal and abnormal results of the current study are useful in determining role of questionnaire and spirometry for asthma diagnoses (Walker *et al.,* 2006). Prevalence of asthma is not found much different in the towns of the city. This similarity in prevalence may be due to regional similarity (Engman *et al.,* 2007).

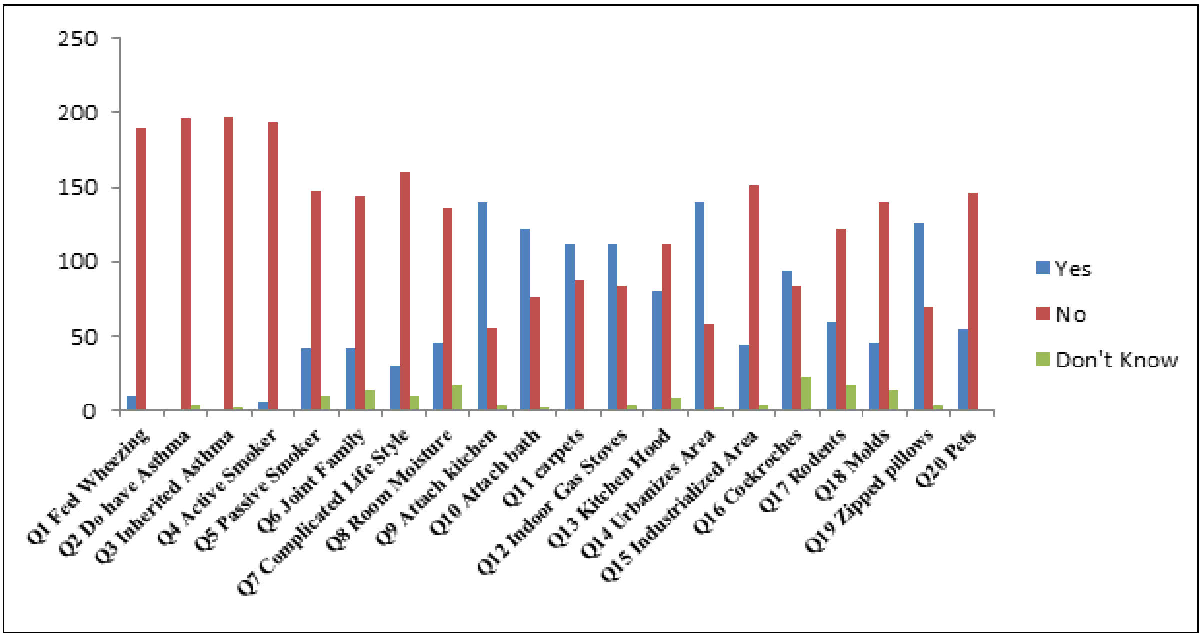

Fig. 5. Questionnaire data of normal subjects.

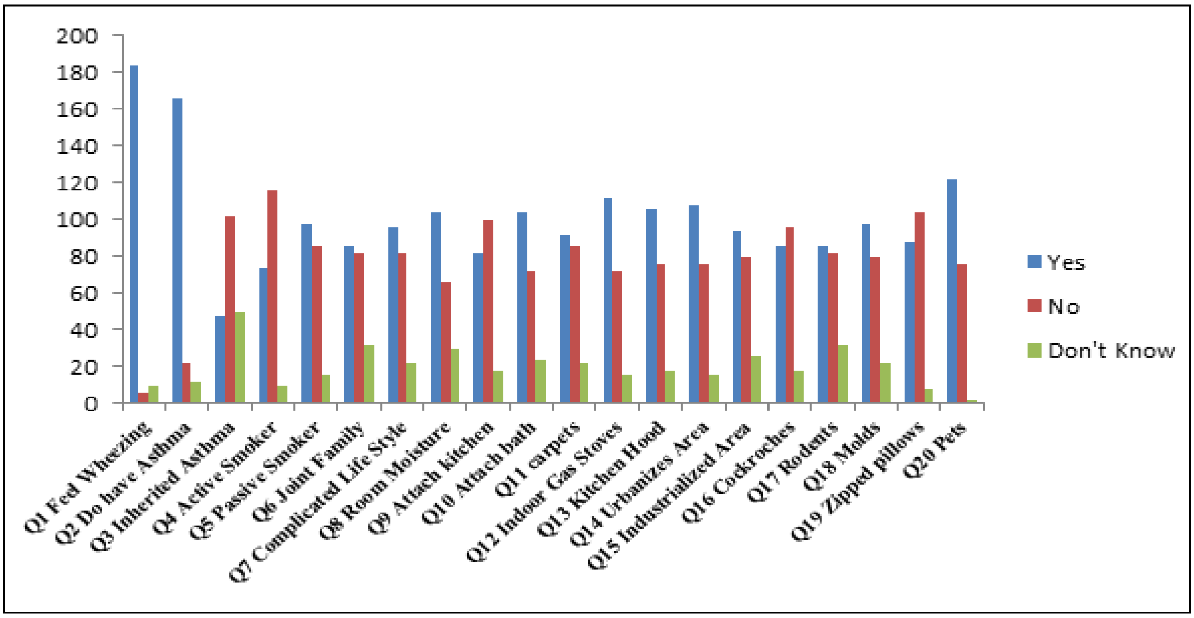

Fig. 6. Questionnaire data of asthmatics.

In our study indoor smoke and burning of fuel aggravate asthma due to indoor cooking with natural gas. A large percentage of subjects with asthma lived in area with extensive exposure to smoke (Smith *et al.,* 2000). According to the current findings, asthmatic subjects were living in areas with lower air exchange rates which have been reported by many studies (Zheng *et al.,* 2013). Mostly asthma is assessed on the basis of symptoms, supplemented by examination of clinical records (BTSSIGN, 2008). Widely used and suitable questions as per clinical practice were used in this research (Reddel *et al.,* 2009). Most of asthma control questionnaire use morbidity questions and optional measure of FEV_1 (Juniper *et al.,* 2007). Many questions gained consensus on short symptom questionnaire correlated with asthma control by Royal College of Physicians UK.

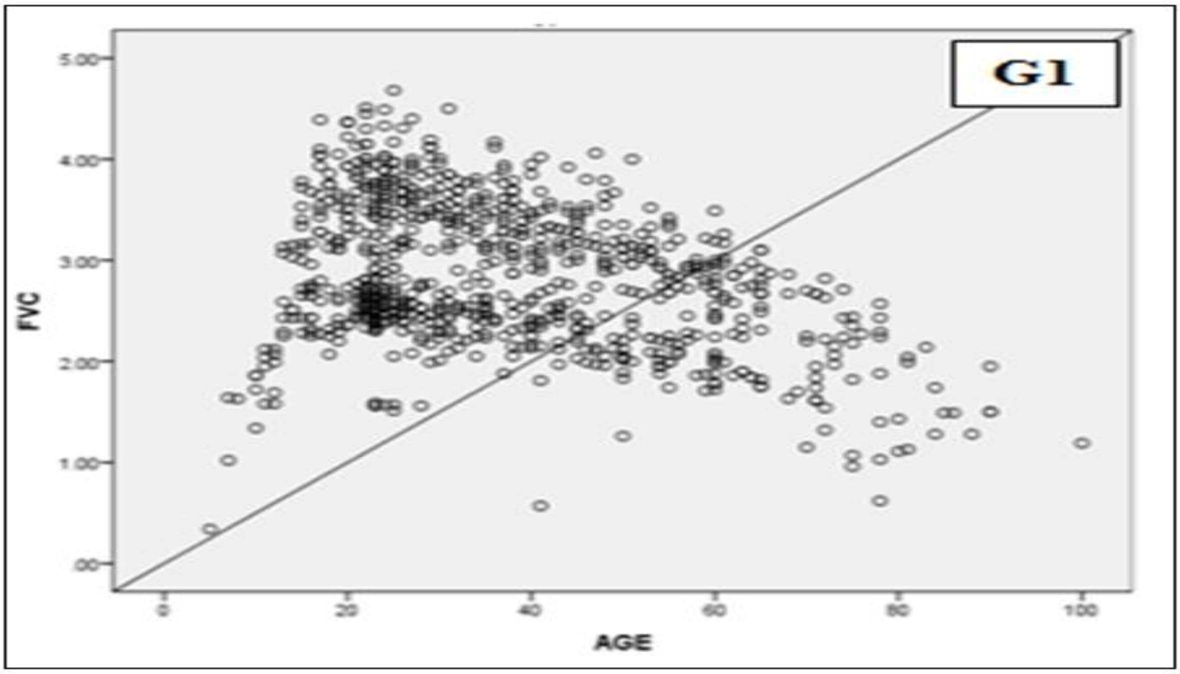

Fig. 7. The relationship between age and FVC values of normal (G1). Pearson correlation coefficient $r = 0.80$, $p < 0.01$.

Our study included subjects from 07-104 years previous research has depicted that questionnaire should be administered to subjects above six years (Juniper *et al.,* 2007). Current study includes asthma subjects to show full range of disease severity, wide range of age among both sees and variety in socioeconomic status reported (Reddel *et al.,* 2009) supports our findings. Wide range of age groups especially lower age limit because delay in diagnoses and wrong assessment regarding severity of asthma can lead permanent lung function decline (Juniper *et al.,* 2007). Environmental factors trigger and aggravate asthma by irritating respiratory passage thus causing inflammation. Fine sand particles originate from local source and may form short term suspension which may cause allergy in asthmatic patients (Al-Dousri and Al-Wahdi, 2012). Such triggers can evoke disease in individuals with asthma tendency. Big cities, bad indoor environment, geographical conditions and anthropogenic activities are allied in terms of creating environmental conditions (Jindal and Wahi, 1991).

Spirometry underuse and unfamiliarity is due to consistency of few pulmonologists with previous reports (Janson and Weiss, 2004). Previously peak flow meters have been in clinical practice for diagnostic purposes instead of spirometer that give highly variable readings (NAEPP, 2007) not only in children even above age of 6 years (Thomas *et al.,* 2009). Even such results were reported by many studies (Aurora *et al.,* 2004). Appropriate interpretation of spirometry data needs correct measurement technique. Similar to our study, mean lower limit of FEV_1 to FVC as limited by lower 90% limit of confidence and 95% confidence intervals for different age categories and of height in women and men (Jindal and Wahi, 1991). According to national asthma guidelines spirometry is much more reliable than physical examination (NAEPP, 2007). Spirometry may be helpful to diagnose some patients with asthma symptoms (Broeders *et al.,* 2009). Many studies have shown spirometric testing feasible to provide ground for diagnosis and management of asthma (Kaminsky *et al.,* 2005). Two such programmes of screening by spirometry were carried out for 651 adults in Netherland offices (Van Schayck *et al.,* 2002). PEF can provide an action plans for disease management (Yoos *et al.,* 2002) because spirometry is common way to measure lung capacity (Paramesh, 2002). Measurement properties (responsiveness, reliability and validity) found in the present study was very similar to as reported (Juniper *et al.,* 2005). Such data can be used to construct a flow vs. time curve useful for diagnosis along with giving predictive indices of respiratory health (Yun *et al.,* 2010). International guidelines focus on the key role of patient education for asthma management and prevention (GINA, 2007).

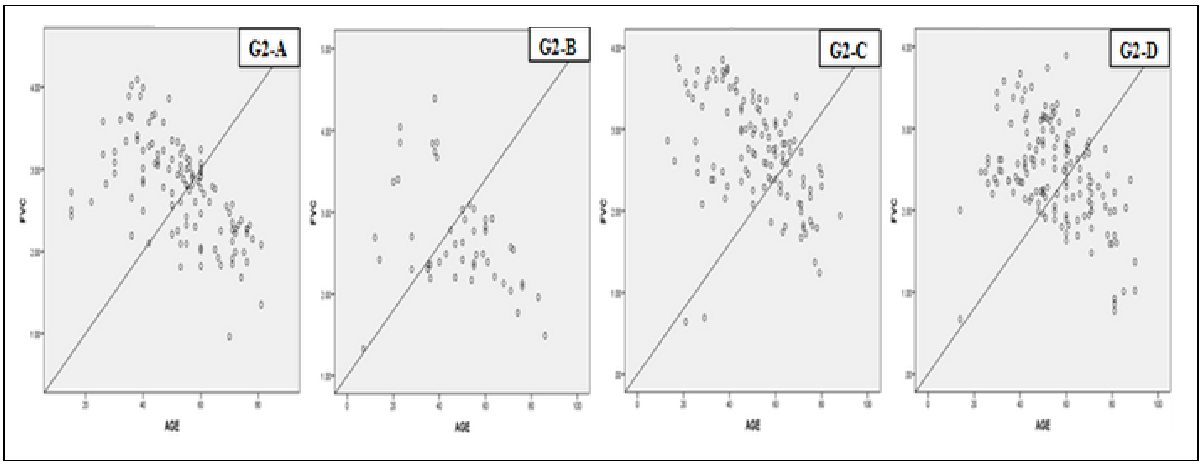

Fig. 8. The relationship between age and FVC values of obstructive (G2-A, B, C & D. Pearson correlation coefficient $r = 0.80$, $p < 0.01$.

In our study spirometry was very sensitively useful in determining moderate and severe situations; obstruction has increased with increase of symptoms. These findings caused considerable doubt over whether FEV_1/ FVC are sensitive enough to exhibit about airway obstruction because few people cannot expire for >1s. If baseline spirometry showed airway obstruction then it is repeated 10-15 min, an increase of 12% in FEV_1 helps to confirm asthma (Osuntogun and Arriaga, 2010). An improvement of more than 15% in FEV_1 in trial is clinically significant. Spirometry can be helpful for bronchodilator response.

As already reported Vollmer *et al.* (2009) subjects with FEV_1/FVC <0.70 have been diagnosed asthmatic on the basis of spirometry. Many studies showed in cross sectional design of study explained that by using <0.70 approaches caused greater prevalence of asthma. By taking FEV_1/FVC <0.70 as reference can lead towards sensitivity/specificity <100%. Valid conclusion also needs diagnostic results comparison (Ferguson *et al.,* 2000). Unluckily few longitudinal studies have been executed for comparing the chances of hospitalization, occurrence and rate of mortality among the subjects diagnosed with FEV_1/FVC <0.70. As reported Bridevaux *et al.,* (2008), it was also found in current study that mild asthma subjects exhibit non-significant FEV_1 decrease as compared to normal function, i.e. FEV_1/FVC>70%. The study (De Marco *et al.,* 2009) included persons between 20 to 44 years and compared FEV_1 decreased hospitalization whereas, this study included the subjects with wider range of age group. Current study support previous work demonstrated moderate to high technical adequacy and ability to describe spirometry (Schermer *et al.,* 2003; Diaz-Lobato *et al.,* 2004; Dales *et al.,* 2005; Ferguson *et al.,* 2000). There is usefulness of spirometry in identification of new asthma cases but no impact on management (Buffels *et al.,* 2004). Walker and colleagues offered “open access spirometry testing” but it provided very little on introduction of spirometry in routine practice (Walker *et al.,* 2006). Chavannes *et al.,* 2004; Kaminsky *et al.,* 2005 used spirometry data to explain the impact of spirometry based on clinical decision.

Current study must be repeated with a larger group. The present study has only taken the impact of 1st spirometry of these subjects and has not taken the impact of repeated spirometry in the management of chronic obstructive lung disease (Schermer *et al.,* 2003; Chavannes *et al.,* 2004).

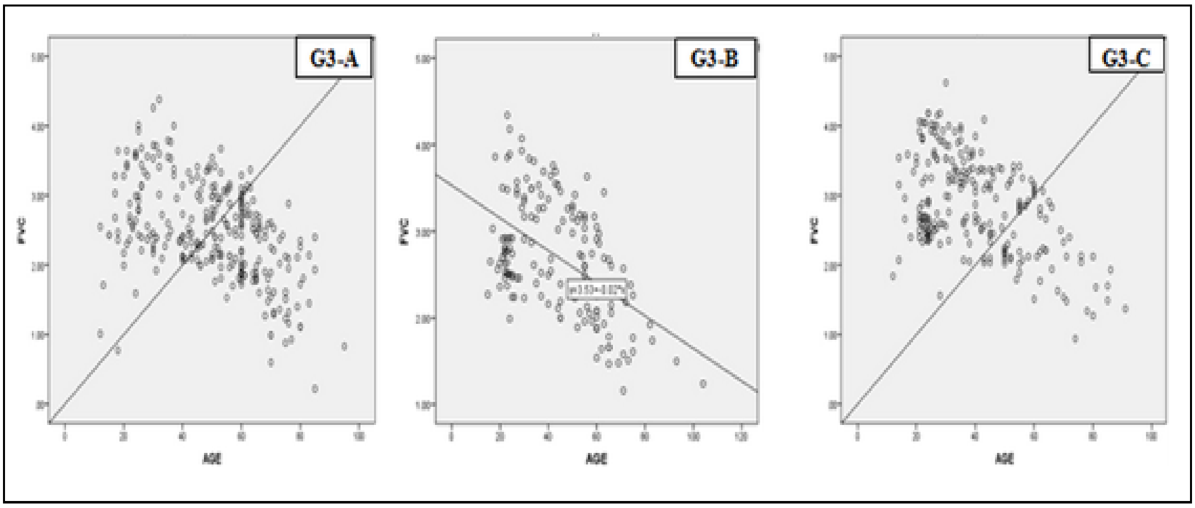

Fig. 9. The relationship between age and FVC values of restriction (G3A, B & C). Pearson correlation coefficient $r = 0.80$, $p < 0.01$.

Conclusion

Lungs function capacity is directly linked with level of obstruction and restriction. With decreasing FVC symptoms, various respiratory problems increase. Various factors present in the houses can be regarded as a potential health hazard to the asthmatic patients at large. It can be harmful to all occupants of these houses in particular. Few precautionary measures are needed to escort safely people at risk. Mostly asthma patients were young and not in practice for the use of spirometry. There is a dire need of to enforcing the safety laws of occupational health by the country health Department.

Acknowledgements

I am thankful to Department of Pulmonology, Jinnah Hospital Lahore for providing me the platform to complete this research work.

References

Akinbami LJ, Schoendorf KC. 2002. Trends in childhood asthma: prevalence, health care utilization, and mortality. Pediatrics **110,** 315-322.

Alam K, Trautmann T, Blaschke T, Majid H. 2012. Aerosol optical and radiative properties during summer and winter seasons over Lahore and Karachi. Atmospheric Environment **50,** 234-245.

Al-Dousri AM. Al-Wahdi J. 2012. Dust fallout in northern Kuwait, major sources and characteristics. Kuwait Journal of Science **39(2A),** 171-187.

Amato GD, Vitale C, Martino AD, Viegi G, Lanza M, Molino A. 2015. Effects on asthma and respiratory allergy of climate change and air pollution. Multidisciplinary Respiratory Medicine **10(39),** 70-76.

Andrew S, Sean B, Stuart G, Lynette S, Michel D, Carol RS. 2012. Major complications, mortality and resource utilization after open abdominal surgery. Annals of Surgery **255(5),** 821-829.

Asthma Clinical Research Network. 2006. History and organization. http://www.acrn.org

Asthma UK. 2008. Key Facts and statistics. http://www.asthma.org.uk/asthma.

Aurora P, Stocks J, Oliver C. 2004. Quality control for spirometry in preschool children with and without lung disease. American Journal of Respiratory and Critical Care Medicine **16,** 1152-1159.

Ayubi E, Safari S. 2017. Bias in association between FEV1/FVC% predicted at 7 years and asthma-chronic obstructive pulmonary disease overlap syndrome. American Journal of Respiratory and Critical Care Medicine **196(1)**, 39-46.

Bergen VVS, Verberne AA, De-Jongste JC, Pijinburgm MW. 2014. Asthma control questionnaires in the management of asthma in children: review. Pediatric Pulmonology **50(2),** 202-208.

Bloom B, Dey AN. 2004. Summary Health Statistics for U.S. Children: National Health Interview Survey **10(227),** 2006.

Bridevaux PO, Gerbase MW, Probst-Hensch NM, Schindler C, Gaspoz JM, Rochat T. 2008. Long-term decline in lung function, utilization of care and quality of life in modified GOLD stage 1 COPD. Thorax **63,** 768-774.

British Thoracic Society-Scottish Intercollegiate Guideline Network. 2008. British Guideline on the Management of Asthma. Thorax **63(4),** 1-121.

Broeders MEAC, Sanchis J, Levy ML, Crompton GK, Dekhuijzen PNR. 2009. On behalf of the ADMIT Working Group. The ADMIT series Issues in Inhalation Therapy. 2) Improving technique and clinical effectiveness. Primary Care Respiratory Journal **18,** 76-79.

Buffels J, Degryse J, Heyrman J, Decramer M. 2004. Office spirometry significantly improves early detection of COPD in general practice. Chest **125(4),** 1394-1399.

Chae EJ, Kim TB, Cho YS, Park CS, Seo JB, Kim N. 2011. Airway measurement for airway remodeling defined by post-bronchodilator FEV1? FVC in asthma: investigation using inspiration-expiration computed tomography. Allergy Asthma and Immunology Research **3(2),** 111-117.

Chavannes N, Schermer T, Akkermans R. 2004. Impact of spirometry on GPs' diagnostic differentiation and decision making. Respiratory Medicine **98,** 1124-1130.

Dales RE, Vandemheen KL, Clinch J. 2005. Spirometry in the primary care setting: influence on clinical diagnosis and management of airflow obstruction. Chest **128,** 2443-2447.

De Marco R, Accordini S, Anto JM, Gislason T, Heinrich J, Janson C. 2009. Long-term outcomes in mild / moderate chronic obstructive pulmonary disease in the European community respiratory health survey. American Journal of Respiratory and Critical Care Medicine **180,** 956-963.

Diaz-Lobato S, Mayoralas S, Buffels J. 2004. Underuse of spirometry in primary care. Chest **126,** 1712.

Eaton T, Withy S, Garrett J, Mercer J, Whitlock RM, Rea HH. 1999. Spirometry in primary care practice: the importance of quality assurance and the impact of spirometry workshops. Chest **116,** 416-423.

Engman LH, Bornehag CG, Sundell J. 2007. How valid are parents' questionnaire responses regarding building characteristics, mouldy odour, and signs of moisture problems in Swedish homes. Scandinavian Journal of Public Health **35,** 125-132.

Fassl BA, Noky FL, Stone BL, Srivastava R, Simon TD, Uchida DA. 2012. The joint commission children's asthma care quality Measures and Asthma Readmissions. Pediatrics **130(3),** 482-491.

Ferguson GT, Enright PL, Buist AS. 2000. Office spirometry for lung health assessment in adults: a consensus statement from the National Lung Health Education Program. Chest **117,** 1146-1161.

Global Initiative for Asthma (GINA). 2006. Global Strategy for Asthma Management and Prevention. http://www.ginasthma.org.

Global Initiative for Asthma (GINA). 2007. Global Strategy for Asthma Management and Prevention. http://www.ginasthma.org.

Guyatt GH, Juniper EF, Feeny DH. 1997. Children and adult perceptions of childhood asthma. Pediatrics **99,** 165-168.

Haczku A, Reynold A, Panettieri J. 2010. Social distress and asthma; the role of corticosteroid intensity. Journal of Allergy and Clinical Immunology **125(3),** 550-558.

Janson S, Weiss K. 2004. A national survey of asthma knowledge and practices among specialists and primary care physicians. Journal of Asthma **41(3),** 343-348.

Jindal SK, Wahi PL. 1991. Pulmonary function laboratory in the tropics: needs, problems and solutions. Lung Biology In Health and Disease 523-542.

John MB, Schuemann B, Fuhlbrigge AL, Hollis BW, Strunk RB, Zeeiger RS. 2010. Serum vitamin D levels and severe asthma management programe study. Journal of Allergy and Clinical Immunology **126(1),** 52-58.

Johns DP, Burton D, Walters JA, Wood-Baker R. 2006. National survey of spirometer ownership and usage in general practice in Australia. Respirology **11,** 292-298.

Juniper E, Gruffydd-Jones K, Ward S. 2007. Developing an interviewer-administered version of the asthma control questionnaire (ACQ) for children f 10 years. European Respiratory Journal **30(51),** 382.

Juniper EF, Bousquet J, Abetz L, Bateman ED. 2006. Identifying 'well-controlled' and 'not well-controlled' asthma using the Asthma Control Questionnaire. Respiratory Medicine **100,** 616-21.

Juniper EF, Svensson K, Mork AC. 2005. Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. Respiratory Medicine **99,** 553-558.

Kaminsky DA, Marcy TW, Bachand M, Irvin CG. 2005. Knowledge and use of office spirometry for the detection of chronic obstructive pulmonary disease by primary care physicians. Respiratory Care **50(12),** 1639-1648.

Khan AA, Tanzil S, Jmali T, Shahid A, Naeem S, Sahito A. 2014. Burden of asthma among children in a developing megacity: childhood asthma study, Pakistan. Journal of Asthma **51(9),** 174.

Krieger J, Jacobd DE, Ashly PJ, Baeder A, Chew JL, Dearborn D. 2014. Housing interventions and control asthama related indoor biologic agents: a review of the evidence. Journal of Public Health Management Practices **16(5),** 11-20.

Krieger J. 2010. Home is where the triggers are increasing asthma control by improving the home environment. Pediatric Allergy Immunology and Pulmonology **23(2),** 23-26.

Lange P, Marrot JL, Vestbo J, Olsen KR, Ingebrigstsen TS, Dahl M. 2012. Prediction of clinical course of chronic obstructive pulmonary diseases, using new gold classification: a study of general population. American Journal of Respiratory and Critical Care Medicine **86(10),** 990.

Magnoni SM, Latorrre M, Bettoncelli G, Sanchez-Herrero MG, Lopez A, Calvo E. 2017.

Asthma control in primary care: the results of an observational cross sectional study in Italy and Spain. World Allergy Organization Journal **10(13),** 1-7.

Malinovschi A, Fonseca Jacinto T, Alving Kjell A, Janson C. 2013. Exhaled nitric oxide levels and blood eosinophils counts independently associate with wheeze and asthma events in national health and nutrition examination survey subjects. Journal of Allergy and Clinical Immunology **132(4),** 821-827.

Mannino DM, Buist AS, Vollmer WM. 2007. Chronic obstructive pulmonary disease in the older adult: what defines abnormal lung function? Thorax **62,** 237-41.

Manuel AR, Matheson MC, Tang CS, Granell R, Ang W, Hui J. 2014. Genome wide association analysis identifies 11 risk variants associated with the asthma with hay fever phenotype. Journal of Allergy and Clinical Immunology **133(6),** 1564-1571.

Melbye H, Drivenes A, Dalbak LG, Leinan T, Hoogh-Henrichson S, Ostrem A. 2011. Asthma chronic obstructive pulmonary disease or both. Diagnostic labeling and respiratory in primary care patients aged 40 years or more. International Journal Chronic Obstructive Pulmonary Diseases **6,** 597-603.

Miller MR, Hankinson J, Brusasco V. 2005. Standardization of spirometry. European Respiratory Journal **26(2),** 319-338.

Minov J, Karadzinska-Bislimovska J, Vasilevska K, Nelovska K, Risteka-Kuc S, Stoleski S. 2012. Smoking among macdonian workers five years after the anti-smoking campaign. Arhiv Za Higijenu Rada I Toksikologiju **63,** 207-213.

Moore WC, Mayer DA, Wenzel SE, Teaguew G, Li H, Li X. 2010. Identification of asthma phenotypes using cluster analysis in the severe.American Journal of Respiratory Critical Care Medicine **181(4),** 315-323.

Yawn BP, Enright PL, Lemanske Jr RF, Israel E, Pace W, Wollan P, Boushey H. 2007. Spirometry can be done in family physicians' offices and alters clinical decisions in management of asthma and COPD. Chest **132(4),** 1162-8.

Nafees AA, Fatmi Z, Kadir MM. Sathiakumar, N. 2013. Patterns and predictors for respiratory illness and symptoms and lungs function among textile workers in karachi Pakistan. Occup Environ Med 2013; 70(2):372-377.

National Asthma Education and Prevention Program. Expert Panel Report 3: Guidelines or the Diagnosis and Management of Asthma. Bethesda, MD: Natl Inst Health Publication **08,** 4051.

O'Dowd LC, Fife D, Tenhave T, Panettieri RA. 2003. Attitudes of physicians toward objective measures of airway function in asthma. The American Journal *of* Medicine. **114(5),** 391-396.

Osuntogun AA, Arriaga RI. 2010. Physician usage of technology and opportunities for continuous care management of pediatric asthma patients. International Conference on Perrasive Computing Technologies Health care **20,** 1-6.

Paramesh, H. 2002. Epidemiology of asthma in India. Indian J Pediatrics **69(4),** 309-312.

Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd, SS. 2004. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. American Journal of Respiratory Critical Care Medicine **163,** 1256-76.

Poels PJP, Schermer TRJ, Jacobs A. 2006. Variation in spirometry utilization between trained general practitioners in practices equipped with a spirometer. Scand Journal of Primary Health Care **24,** 81-87.

Raghunath AS, Innes A, Norfolk L. 2006. Difficulties in the interpretation of lung function tests in the diagnosis of asthma and chronic obstructive pulmonary disease. Journal of Asthma **43,** 657-660.

Rasheed A, Aneja VP, Aiyyer A, Rafique U. 2015. Measurement and Analysis of Fine Particulate Matter (PM2.5) in Urban Areas of Pakistan. Aerosol Air Quality Research **15(2),** 426-439.

Reddel HK, Taylor DR, Bateman ED. 2009. An Official American Thoracic Society/European Respiratory Society Statement: Asthma Control and Exacerbations: Standardizing Endpoints for Clinical Asthma Trials and Clinical Practice. American journal of respiratory and critical care medicine **180,** 59-99.

Reinero CR. 2011. Advances in the understanding of pathogenesis and diagnostics and therapeutics for feline allergic asthma. The Veterinary Journal **190(1),** 28-33.

Rhee CK, Yoon H, Hyoung HK, Yoo KH, Kim YS, Lee SW, Park YB. 2014. Medical utilization and cost in patient with overlap syndrome of chronic obstructive pulmonary disease and asthma. Journal of Chronic Obstructive Pulmonary Diseases **11(2),** 163-170.

Schermer TR, Jacobs JE, Chavannes NH. 2003. Validity of spirometric testing in a general practice population of patients with chronic obstructive pulmonary disease. Thorax **58,** 861-866.

Shah SI, Arooj F. 2019. Outdoor Air Quality as Influenced by Vehicular Exhaust in Metropolitan City of Lahore, Pakistan. Pakistan Journal of Scientific & Industrial Research Series A: Physical Sciences **62(3),** 190-196.

Sidra S, Ali Z, Sultan S, Ahmed S, Colbeck I, Nasir ZA. 2015. Assessment of airborne micro flora in the indoor micro-environments of residential houses of Lahore, Pakistan. Aerosol and Air Quality Research **15(6),** 2385-2396.

Smith KR, Samet JM, Romieu I. 2000. Indoor air pollution in developing countries and acute lower respiratory infections in children. Thorax **55,** 518-532.

Sun YX, Sundell J, Zhang Y F. 2007. Validity of building characteristics and dorm dampness obtained in a self-administrated questionnaire. Sci Total Environ **387,** 276-282.

Tasai CH, Huang JH, Hwang BF, Lee YL. 2010. Household environmental tobacco smoke and risks of asthma, wheeze and bronchitis symptoms among children in Taiwan. Respir Res **11(11),** 9921-9925.

Tashkin DP, Cooper CB. 2004. The role of long-acting bronchodilators in the management of stable COPD. Chest **125,** 249-259.

Thomas M, Gruffydd-Jones K, Stonham C, Ward S, Macfarlane T. 2009. Assessing 67 asthma control in routine clinical practice: use of the Royal College of Physicians '3 Questions'. Primary Care Respiratory Journal **18,** 83-88.

Thomas SD, Whitman S. 1999. Asthma hospitalizations and mortality in Chicago: an epidemiologic overview. Chest **116,** 135S-141S.

UN, 2019. World Population prospects 2019. Pakistan Metro Area Population 1950-2020. https://www.macrotrends.net/cities/22046/lahore/population/Lahore.

Van Schayck CP, Loozen JMC, Wagena E, Akkermans RP, Wesseling GJ. 2002. Detecting patients at a high risk of developing COPD in general practice: cross-sectional case finding study. BMJ **324,** 1370-1375.

Vaz Fragoso CA, Concato J, McAvay G, Van Ness PH, Rochester CL, Yaggi HK, Gill TM. 2010. Chronic obstructive pulmonary disease in older persons: a comparison of two spirometric definitions. Respiratory Medecine **104(8),** 1189-96.

Vollmer WM, Gislason T, Burney P, Enright PL, Gulsvik A, Kocabas A, Buist AS. 2009. Comparison of spirometry criteria for the diagnosis of COPD: results from the BOLD study. European Respiratory Journal **34,** 588-97.

Wadson SJ, Sanford AW. 2013. Personalized medicine and asthma diagnosis/ management. Current Allergy and Asthma Reports **13(1),** 118-129.

Wadsworth SJ, Sandford AJ. 2013. Personalized medicine and asthma diagnostic medicine/ management. Current Allergy and Asthma Reports **13(1),** 118-129.

Walker PP, Mitchell P, Diamantea F. 2006. Effect of primary care spirometry on the diagnosis and management of COPD. European Respiratory Journal **28,** 945-952.

Yawn BP, Enright PL, Lemanske RF Jr. 2007. Spirometry can be done in family physicians' offices and alters clinical decisions in management of asthma and COPD. Chest **132(4),** 1 162-11.

Yeatts K, Davis KJ, Sotir M, Herget C, Shy C. 2003. Who gets diagnosed with asthma, frequent wheeze among adolescents with and without a diagnosis of asthma? Pediatrics **111,** 1046 -1054.

Yoos HL, Kitznian H, MeMullen A, Henderson C, Sidora K. 2002. Symptom monitoring in childhood asthma: a randomized clinical trial comparing peak expiratory flow rate with symptom monitoring. Annals of Allergy Asthma and Immunology **88,** 283-91.

Yun TJ, Jeong HY, Lee HR, Arriaga RI. Abowd GD. 2010. Assessing asthma management practices through in-home technology probes. Pervasive Computing Technologies Healthcare 1-9.

Zheng XH, Qiang H, Zhao YL. 2013. Home risk factors for childhood pneumonia in Nanjing, China. Chinese Science Bulletin **58,** 4230-4236.